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TECHNOLOGY ASSESSMENT AND THE FOURTH DISCONTINUITY: THE LIMITS OF INSTRUMENTAL RATIONALITY

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It has been said that mankind stands today at the brink of a precipice as deep as the three ego-smashing divides that our species has already traversed in its intellectual history.¹ The first crossing, signalled by the Copernican revolution if not earlier, dislodged man from his seat at the center of the universe by establishing a continuity in his perception between the earth he inhabited and the physical bodies he observed in the heavens. The second, heralded by Darwin, dethroned mankind from its secure place at the pinnacle of life by bridging the gap that had separated it from the rest of the animal kingdom. And the third crossing, due largely to the work of Freud, challenged the supremacy and autonomy of the human ego by linking the primitive and archaic in man with the civilized and the evolved. But this sequence is not yet complete. There remains, it is said, a fourth great discontinuity²—that between man and his machines—which must be bridged if man is to live in harmony with his tools, and hence with himself. The only alternative to such unified coexistence, according to this view, is the dilemma of either rejecting man's technologies in Luddite panic—or becoming their slaves. In this Article, I will argue that bridging this "fourth discontinuity"—truly regarding and treating our technologies as parts of ourselves—is tantamount to developing certain modes of thought and action that lie outside the domain of instrumental rational-

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1. Mazlish, *The Fourth Discontinuity*, 8 *TECHNOLOGY AND CULTURE* 1 (1967).

2. Indeed, I shall later note a fifth (*see* note 137 *infra*), and there is no reason to suppose that the journey's end will ever be discerned.

ity, which I will take to signify *the selection of efficacious means to previously given ends*.

In discussing the boundaries of instrumental rationality so conceived, it will become clear that the focus of this Article is not on the limits of rationality as such, but rather on the limits of *that form of rationality which seeks to discriminate among alternative actions by assessing their comparative tendency to advance or to retard the achievement of the actor's goals or values*. In terms of the classical distinction drawn by Weber, the limits I mean to discuss are those of the *zweckrational* ("purpose-rational") rather than the *wertrational* ("value-rational") orientation,³ where the latter is taken to encompass the determination of action "by the conscious faith in the absolute worth of the conduct as such, independent of any aim, and measured by some such standard as ethics, aesthetics, or religion."⁴ But, in our attempt to explore the limits of the "purpose-rational" or "instrumental" orientation, I believe we will discover that the most fundamental limit of all attaches to a conception of choice and of the subject-object relationship that is in some respects more basic than any particular notion of what rationality entails. That is, I believe we will find that the largest questions which instrumental rationality cannot answer are questions which will remain unanswerable so long as one adheres to a conception in which objectives and choices are regarded as things ("objects") selected by the actor (the "subject") on a basis which must always rest on an irreducibly arbitrary and subjective element. Any such conception must fail in one of two ways: either it must ignore the crucial respects in which a person's or community's "chosen" actions alter the characteristics of the chooser—or, if it does not ignore them, it must yield a disconnected notion of the chooser as a series of selves lacking temporal continuity and of persons as objects profoundly isolated, sharing nothing truly personal and yet enduring with one another.

The alternative conception whose contours I will sketch is one which rejects the notion of choices as invariably the *products* rather than the *constituents* of human identity and will, and posits instead that human actions define who and what the actor is. The conception I have in mind is one that perceives actor and action, subject and object, as inseparably linked within a unity of reason and will that transcends them both, so that the whole of which they are parts retains an integrated identity over time and touches a community-wide core of

3. MAX WEBER ON LAW IN ECONOMY AND SOCIETY 1 (M. Rheinstein ed. 1954).

4. *Id.*

shared ends. I will try to show how some alternative conception of this sort, as applied to technological choices in particular, may make it possible to perceive and act upon an ultimate continuity between man and his tools *without thereby reducing human individuals or societies to the mere "products" of man's technological activity*. It is in this way, I will suggest, that an alternative conception of choice appears to prove vital simultaneously to the successful completion of two seemingly unrelated tasks: the transcendence of instrumental rationality, and the satisfactory bridging of the fourth discontinuity. The central ambition of this Article is simply *to sketch how these two tasks are in fact related*. There is no thought here of "accomplishing" either one of them; doing that seems to me the work of several lifetimes, and is a mission ultimately beyond the reach of theory alone.⁵

At this point, let me be explicit about the place of modern technology in the ensuing discussion. Although I intend to begin and end my analysis with investigations of contemporary technology-related phenomena, I do so not because characteristics peculiar to these contemporary phenomena are crucial to my argument. Rather, I have selected the context of contemporary technology for this Article because the problems one encounters in trying to rationalize technological choice in the current era illustrate ideally the boundaries beyond which instrumental rationality cannot reach and show the respects in which learning to navigate beyond those boundaries requires approaches which also prove helpful in fashioning a harmonious relation between modern societies and the technological choices confronting them. In our historical situation, therefore, coming to terms with technology becomes a particularly suitable lens through which to view the more general and universal problem of transcending instrumental modes of thought.

I. THE BACKGROUND OF RECENT TECHNOLOGICAL CONCERN

A large number of strands in our social history converged during the late 1960's in a widespread concern, or at least a widespread assertion

5. I do not here address the complex problems posed by the fact that this Article represents at the same time (1) a "formal" (though not yet fully rigorous) analysis of a system of ideas and its logical entailments, and (2) a "factual" (though not yet fully researched) study of a social-historical situation, its causes, and its cures. The methodological and other issues presented by sorting out these two levels of argument and ultimately finding a mode of discourse that satisfactorily links them to one another remain to be explored in further work.

of concern, with technological control and, as a special case of the latter, with environmental protection. One might try to identify particular galvanizing events: the publication of Rachel Carson's *Silent Spring*,⁶ alerting the public to the dangers of environmentally blind technological development; the projection, from 20,000 miles in space, of photographs revealing the earth as a dramatically finite and surprisingly delicate blue-green globe;⁷ the sudden dramatization of the fact that people could in fact "stop" technology, as in the frequently effective public protests against urban renewal and highway construction.⁸

Alternatively, one might point not to these episodic events but rather to certain objectively discernible trends converging in a widespread concern with technological control: the rapid growth of technology itself in terms of volume, complexity, and physical reach; the diminishing time span between initial technological innovation and widespread application; the increasing numbers, densities, and interdependence of the populations affected by technology; a deepening ability to perceive the consequences of technological advances; and a growing range of alternative technologies among which choices have become possible.⁹

Finally, one should note the underlying movements of thought and feeling that have spelled a growing estrangement from things technical and hierarchical, and hence a widening gap between social structure and cultural order, between institutions and the inner life.¹⁰ It is those movements that give coherence to what might otherwise have seemed an unconnected set of phenomena. Whatever one's perception of where the threads originated and how they have been woven together, the emerging pattern has been unmistakable: an increasingly

6. R. CARSON, *SILENT SPRING* (1962).

7. I am indebted to Murray Gell-Mann for leading me to realize how powerful a symbol this has proved to be in stirring public awareness.

8. The White House National Goals Research Staff has referred to these latter episodes as "people's technology assessment." See REPORT OF THE NATIONAL GOALS RESEARCH STAFF, TOWARD BALANCED GROWTH: QUANTITY WITH QUALITY 122 (1970).

9. REPORT OF THE NATIONAL ACADEMY OF SCIENCES, TECHNOLOGY: PROCESSES OF ASSESSMENT AND CHOICE 12-15, 79 (1969) [hereinafter cited as TECHNOLOGY ASSESSMENT REPORT]. Particularly since I shall from time to time be quite critical of the assumptions underlying the TECHNOLOGY ASSESSMENT REPORT, I should say at this point that, as Executive Director of the Technology Assessment Panel which undertook the study leading to the report, I authored the document. The panel's Chairman was Dean Harvey Brooks of the Harvard Division of Engineering and Applied Physics.

10. See, e.g., Bell, *The Post-Industrial Society: the Evolution of an Idea*, 79 SURVEY 102 (1971).

shared sense that our society's technological capabilities have moved out of phase with our capacity to understand and direct their development, to humanize and contain their impact, and to integrate their evolution with our cultural and natural lives.

II. THE CHARACTER OF THE DOMINANT RESPONSE

Although a variety of reactions to the concern for technological control has begun to emerge, the primary response in government, business, universities, and other large institutions has been to extend prevalent notions of rational planning and policy evaluation so as to broaden the range of factors (spread over time as well as over the spectrum of affected interests) reflected in technological choice. If military power or market profits appear to reflect too narrow a set of impacts or measurements, the prescription has been simply to alter the institutional matrix of choice in ways calculated to inject the considerations that have been left out. The National Academy of Engineering even numbered the steps thought appropriate for technological planning:

- (1) Identify and refine the subject to be assessed.
- (2) Delineate the scope of the assessment and develop a data base.
- (3) Identify alternative strategies to solve the selected problems with the technology under assessment.
- (4) Identify parties affected by the selected problems and the technology.
- (5) Identify the impacts on the affected parties.
- (6) Valuate or measure the impacts.
- (7) Compare the pros and cons of alternative strategies.¹¹

The upshot of approaches to technological control such as that suggested by the National Academy of Engineering,¹² if they are to make

11. REPORT OF THE COMMITTEE ON PUBLIC ENGINEERING POLICY, NATIONAL ACADEMY OF ENGINEERING, A STUDY OF TECHNOLOGY ASSESSMENT 25-26 (1969).

12. The idea of "technology assessment" expressed by the sequence of steps set forth in the text grew largely out of the work of the House Science and Astronautics Committee under the leadership of Congressman Emilio Daddario. The Committee commissioned several studies to explore the conceptual and operational questions posed by the notion. One study, the TECHNOLOGY ASSESSMENT REPORT noted earlier (*see note 9 supra*), was primarily concerned with theoretical and institutional considerations; another, that quoted in the text, focused largely on matters of methodology and practice, and proceeded by undertaking three "pilot studies" (of subsonic aircraft noise, computer-

any difference in existing practice, is to replace such narrow indices as economic profit with broader but equally "objective and impersonal measures"¹³ to serve as indicators of social utility.¹⁴ As Dean Harvey Brooks of the Harvard Division of Engineering and Applied Physics once expressed it, technology assessment has thus been conceived as "a technology in itself—a technology for measuring and monitoring . . . social performance . . ."¹⁵ And, in keeping with this conception, the underlying faith has commonly been that the "optimal [social] course is likely to result from an engineering balance of costs and benefits rather than from immutable first principles."¹⁶

As a result of such a conception, the task of technological assessment is typically reduced to that of providing objectively sounder bases for selecting, in the course of whatever public or private decisions influence the direction of technological development, the appropriate technical means from the growing set of options science can make available to achieve individually or collectively expressed ends.¹⁷ And, as to the ends themselves, little is said, for "there . . . is no agreed upon algebra by which one can . . . subtract the pains from the pleasures in order to arrive at a net index of social desirability."¹⁸

aided instruction, and multiphasic health screening) to develop the necessary techniques. For a critique of the narrowness of these pilot studies, see Folk, *The Role of Technology Assessment in Public Policy*, in *TECHNOLOGY AND MAN'S FUTURE* 246, 250-51 (A. Teich ed. 1972) [hereinafter cited as Folk].

13. Address by Dean Harvey Brooks, at Industrial Research Institute, Washington, D.C., *What Can Technology Do About Technology* 9, Oct. 14, 1970 [hereinafter cited as Brooks].

14. See also Kranzburg, *Historical Aspects of Technology Assessment* 1, 20, August 1969 (Program of Policy Studies in Science and Technology, Occasional Paper No. 4, George Washington University).

15. Brooks, *supra* note 13, at 9. More recently, however, Dean Brooks has expressed misgivings about the value of conceiving of technology assessment as a methodology or an intellectual "tool." See, e.g., Address by Dean Harvey Brooks, at Carleton College, *Technology Assessment Reconsidered* 4, Nov. 16, 1971.

16. *TECHNOLOGY ASSESSMENT REPORT*, *supra* note 9, at 79.

17. "Technology assessment . . . is designed to provide an objective and neutral input to public decisionmaking and policy formulation with regard to science and technology." V. COATES, *SUMMARY REPORT: TECHNOLOGY AND PUBLIC POLICY: THE PROCESS OF TECHNOLOGY ASSESSMENT IN THE GOVERNMENT* 1 (1972).

18. *TECHNOLOGY ASSESSMENT REPORT*, *supra* note 9, at 29. Indeed, the 1960's bred a faith that the most important disputes would not focus on ends at all. A good example of this end-of-ideology view is provided by Arthur Schlesinger's account of John Kennedy's conversation with André Malraux in the spring of 1962. "The real issue today," the new President is said to have told Malraux, is "the management of industrial society—a problem . . . not of ideology but of administration. . . . A few days later, speaking to the White House conference on national economic issues, the President elaborated:

"Technology assessment," therefore, has been characterized as merely a special type of policy assessment. "[I]t encompasses the first three steps of the policymaking process . . . :

- (1) identifying possible outcomes . . . ;
- (2) estimating the . . . probability of each . . . ; and
- (3) estimating the utility or disutility of each of the outcomes to the interested parties. . . .

It generates data for the decision-maker, who carries out the fourth step . . . :

- (4) weighing the utilities and disutilities to the interested parties and deciding if the policy alternative [under consideration] is better than other alternatives."¹⁹

Under this sort of view, it is widely recognized that technology assessment—like any other form of applied policy analysis—can become a weapon for the disguised advancement of narrow interests. It is believed, however, that a pluralistic system of countervailing critiques and pressures can adequately combat this danger in a political order conceived, within the broad liberal tradition, largely as a mechanism for resolving conflicting claims and aggregating competing interests,

"[T]he fact of the matter is that most of the problems, or at least many of them, that we now face are technical problems [calling for] . . . very sophisticated judgments which do not lend themselves to the great sort of 'passionate movements' which have stirred this country so often in the past"

A. SCHLESINGER, *A THOUSAND DAYS* 644 (1965).

19. Folk, *supra* note 12, at 246-47. Indeed, a widely held preference among technology-assessment proponents is for minimizing the role of any collective determination by making maximum use of market mechanisms. As Harvey Brooks has noted, the resurgence of interest in injecting indices of social performance into self-regulating markets rests not only on disillusion with bureaucratic administration but also on a rediscovery, within economics, of the invisible hand of English political economy as "rejuvenated by modern econometrics and feedback theory imported from electrical engineering" (Brooks, *supra* note 13, at 8; see also *TECHNOLOGY ASSESSMENT REPORT*, *supra* note 9, at 55, 139)—a rejuvenation that makes possible, I would add, the seemingly technical "solution" of human motivational problems. And, when technological notions are not invoked to justify preferences for individualistic, market-oriented solutions at the institutional level, they tend to be invoked in the shaping of particular responses to specific technology-related problems. See, e.g., Address by Dean Harvey Brooks, at Xerox Symposium, Rochester, N.Y., *The Political Climate for Technology* 13-16, Sept. 29, 1970, discussing his and Ivan Bennett's concept that "completing" such "half-way" technologies as present waste-disposal methods or nuclear power production might go a long way toward solving environmental ills. My point here is not that these tendencies necessarily (or even often) lead to undesirable policy prescriptions, but merely that they illustrate the almost exclusively *instrumental* character of current technology-assessment thinking, a limitation whose significance I will presently explore.

rather than as a structure for shaping a community's common existence and shared destiny.²⁰

This pattern of thought has been equally characteristic of the dominant governmental and institutional response to the growing awareness of environmental problems: simply broaden the policy analysis to consider environmental (in addition to "narrowly economic") costs and benefits, and then rely on the pluralistic play of pressures and counterpressures to generate "better" solutions. The approach of the National Environmental Policy Act of 1969,²¹ for example, is essentially to require federal agencies to broaden their calculus of decision by considering, and issuing public "impact statements" about, the environmental consequences of their contemplated actions. And the Technology Assessment Act of 1972²² rests on a principle that resembles even more closely the traditional notion of policy assessment as a purely informational activity, one whose only mission it is to generate facts on the basis of which decision-makers can then make sounder choices. For the Technology Assessment Act imposes no new substantive obligations on existing agencies, and imposes no new procedural obligations apart from the duty to "furnish the information, suggestions, estimates, statistics, and technical assistance"²³ requested by the Office of Technology Assessment²⁴ in discharging its responsibilities to "provide early indications of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information which may assist the Congress."²⁵

20. See TECHNOLOGY ASSESSMENT REPORT, *supra* note 9, at 87. Cf. note 132 and text accompanying notes 130-32 *infra*.

21. 42 U.S.C. §§ 4321 *et seq.* (1970).

22. 86 Stat. 797 (1972).

23. *Id.* at § 6(d).

24. The Office, created by § 3, consists of a non-voting Director, six Senators, and six Representatives, each group divided equally between the two major parties. *Id.* at § 4(a).

25. *Id.* at § 3(c). In carrying out this function, the Office is directed to:

(1) identify existing or probable impacts of technology or technological programs;

(2) where possible, ascertain cause-and-effect relationships;

(3) identify alternative technological methods of implementing specific programs;

(4) identify alternative programs for achieving requisite goals;

(5) make estimates and comparisons of the impacts of alternative methods and programs;

(6) present findings of completed analyses to the appropriate legislative authorities;

(7) identify areas where additional research or data collection is required to provide adequate support for the assessments and estimates described in paragraph (1) through (5) of this subsection; and

(8) undertake such additional associated activities as the appropriate authorities . . . may direct.

Both the intellectual elaboration of technology assessment and environmental sensitivity as antidotes to overly narrow bases for decision, and the institutional embodiment of such antidotes in federal statutory law, thus display a common—and quite limited—structure: *consider more facts—a wider range of “impacts” and “interests”—in choosing the optimal means to fit existing ends.* The remainder of my critique will be addressed to this conception of technology assessment as a form of applied policy analysis in which the mission is to rationalize decision-making by broadening the range of interests considered when matching means to ends. Part III will suggest areas of needed improvement in policy-analytic techniques as currently developed and applied. Part IV will then examine what I believe to be the inherent limits of all such methods, however carefully perfected or thoughtfully pursued.²⁶ Finally, Part V will explore the latter limits in several concrete technological settings, returning in that context and in Part VI to the thesis about the fourth discontinuity with which this Article began.

III. FLAWS WITHIN THE POLICY-ANALYTIC SCHEME

There are two basic respects in which policy-analytic methods in general are currently flawed and in need of refinement.²⁷ The first is the tendency to reduce the various dimensions of a problem to terms that misstate their underlying structure and ignore the structural features that give them their total character; the second is the almost universal tendency to focus on end results while largely ignoring questions of process.

A. REDUCING STRUCTURE

Contemporary policy-analytic techniques, derived largely from welfare

Nothing said here should be taken to suggest that the two statutes described above are unimportant or undesirable—merely that they share the characteristic limits of the policy-analytic tradition that they exemplify.

26. Any reader who has consulted Tribe, *Policy Science: Analysis or Ideology?*, 2 PHIL. & PUB. AFFAIRS 66 (1972) [hereinafter cited as *Policy Science*], may therefore wish to turn directly to Part IV, although the analysis in Part III is more explicit than that of the prior article with respect to why certain difficulties persist and how they might be remedied.

27. Part III draws heavily upon *Policy Science*, *supra* note 26, which elaborates in greater detail the flaws discussed *infra*, as well as other failings of classical policy-analytic methods, and undertakes to explore the patterns and purposes suggested by such flaws, even if they are remediable rather than inherent in policy science as such. It should be stressed that the aim of Part III is a modest one: merely to indicate *areas of needed improvement* in the techniques of policy analysis. It should thus be clear that the difficulties to which Part III draws attention are not, in my view, *logically* required by the structure of the policy-analytic methods I am discussing.

economics, operations research, and such areas of management science as decision theory, typically proceed by (1) describing systematically the alternatives open to a decision-maker and the constraints surrounding them; (2) eliciting the decision-maker's preferences (or those of the constituency on whose behalf he is acting) with respect to all the outcomes that might result from each alternative action; (3) helping the decision-maker assess the probability of each such outcome; and (4) applying various mathematical techniques to determine which action or sequence of actions, within the range of alternatives open, yields the maximum "expected utility" in terms of the decision-maker's preferences.²⁸

In practice the procedure tends to be far less tidy than this sequence might suggest, particularly when a policy problem is highly complex, when it is unclear at the outset what alternatives are worth considering, and when the assignment of preferences is rendered problematic by the existence of several different attributes or interests in terms of which each outcome must be ranked. When such difficulties are encountered, which is of course very common, the usual approach is as follows: (1) sketch a tentative description of the decision-maker's objectives or goals; (2) search for a plausible set of alternative strategies for achieving those objectives; (3) utilizing any of a large number of available mathematical and intuitive techniques, select the alternative that seems "best" in terms of the objectives posited; (4) reconsider the objectives in light of what the analysis has revealed—and, if necessary, begin anew.²⁹ So perceived, the aim of policy-analytic techniques is not to "substitute for the experience, the intuition, and the judgment of the decision-maker," but to "sharpen that intuition and judgment by stating problems more precisely, by discovering new alternatives, and by making explicit the comparison among alternatives."³⁰

Needless to say, the problem of systematic comparison lies near the heart of the endeavor to utilize policy-analytic methods of decision.

28. See generally R. MCKEAN, *EFFICIENCY IN GOVERNMENT THROUGH SYSTEMS ANALYSIS* (1958); H. RAIFFA, *DECISION ANALYSIS: INTRODUCTORY LECTURES ON CHOICES UNDER UNCERTAINTY* (1968); Hinrichs, *Government Decision Making and the Theory of Benefit-Cost Analysis: A Primer*, in *PROGRAM BUDGETING AND BENEFIT-COST ANALYSIS* 9-20 (H. Hinrichs & G. Taylor eds. 1969). For a more technical and exhaustive account, see H. WAGNER, *PRINCIPLES OF OPERATIONS RESEARCH* (1969).

29. See, e.g., Rowen, *Objectives, Alternatives, Costs, and Effectiveness*, in *PROGRAM BUDGETING AND BENEFIT-COST ANALYSIS* 83-93 (H. Hinrichs & G. Taylor eds. 1969); Enthoven, *The Systems Analysis Approach*, in *id.*, at 159-68; Haldi, *The Role of Analysis*, in *id.*, at 151-59.

30. Rowen, *supra* note 29, at 83.

If analysis yields a result that still requires the decision-maker in the end to make difficult intuitive choices between alternatives that differ in some incommensurable way,³¹ he may conclude that the analysis was not worth the cost and that he might as well have relied on his intuition from the outset.³²

Moreover, analysis is often intended not only to aid the decision-maker in choosing a course of action, but also to help him in *persuading others* of the justifiability and wisdom of his choice.³³ The usefulness of analysis in such advocacy is drastically reduced whenever it does not at least *appear* to point objectively and unambiguously toward a particular alternative. Thus, the users of policy-analytic techniques are under constant pressure to reduce the many dimensions of each problem to some common measure in terms of which "objective" comparison seems possible—even when this means squeezing out "soft" but crucial information merely because it seems difficult to quantify or otherwise render commensurable with the "hard" data in the problem.³⁴ Thus, because policy-analytic techniques prove most powerful when the various dimensions of a question are reduced to a common denominator, or at least to smoothly exchangeable attributes,³⁵ the continuing tendency that accompanies analytic techniques is to engage in such reduction whenever possible, with the result not only that "soft" variables tend to be ignored or understated but also that *entire problems tend to be reduced to terms that misstate their underlying structure and ignore the "global" features that give them their total character.*³⁶

31. As, for example, when alternative *X* generates substantially more income for the community than *Y* but *X* exacerbates the inequality of income distribution, or where *X* yields broader recreational opportunities than *Y* but at a greater sacrifice to wildlife and to future generations.

32. It should be recognized, of course, that reducing a problem to a form compact enough to facilitate the application of intuitive judgment might in itself be a highly valuable achievement, as might the recasting of a problem in a way that exposes alternatives not initially considered. See generally *Policy Science*, *supra* note 26, at 103 n.105; de Neufville & Keeney, *Use of Decision Analysis in Airport Development for Mexico City*, in *ANALYSIS OF PUBLIC SYSTEMS* 64-74 (A. Drake, R. Keeney & P. Morse eds. 1972); Keeney & Raiffa, *A Critique of Formal Analysis in Public Decision Making*, in *id.* at 497-519.

33. See, e.g., Keeney & Raiffa, *supra* note 32, at 65, 71-73; Schlesinger, *Uses and Abuses of Analysis*, in *PROGRAM BUDGETING AND BENEFIT-COST ANALYSIS* 346-58 (H. Hinrichs & G. Taylor eds. 1969); *TECHNOLOGY ASSESSMENT REPORT*, *supra* note 9, at 87.

34. See also Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329, 1361-65, 1389-90 (1971) (discussion of the "dwarfing of soft variables") [hereinafter cited as *Trial by Mathematics*].

35. See A. RIVLIN, *SYSTEMATIC THINKING FOR SOCIAL ACTION* 7 (1971).

36. See *Policy Science*, *supra* note 26, at 84-97.

An instructive example is provided by the now quite traditional application of policy-analytic and microeconomic techniques to the legal problem of how to assign basic rights and liabilities. If a technology involving a dazzling light-show were developed, for instance, that could give great pleasure to the people in group *X* but only at the cost of temporarily blinding the people in group *Y*, the question might arise: should the members of *Y* have a "right" to the uninterrupted enjoyment of their eyesight, requiring the members of *X* to refrain from using the technology, and to compensate the members of *Y* if they do use it, unless they have purchased in advance the consent of all the members of *Y*—or should the members of *X* instead be accorded a "right" to the pleasure this technology can bring, requiring the members of *Y* to suffer temporary blindness unless they have purchased in advance the forbearance of all the members of *X*? The currently popular analysis, traceable primarily to the seminal work of Ronald Coase³⁷ and Guido Calabresi,³⁸ is roughly as follows: If the market operated perfectly—with free competition, full information, and no costs attached to arranging and enforcing agreements—then the members of *X* and *Y* would bargain their way to an equally "efficient" outcome³⁹ regardless of which way the law assigned "rights." If instead some of the conditions for a perfect market are not met (the typical case), all we need do (apart from distributive considerations) is *minimize the sum of blindness costs and blindness-avoidance costs* (since it is net total wealth we wish to maximize); and the most efficient way to achieve that result is to impose liability for damages on whichever party is in the best position to make the requisite cost-benefit analysis between blindness costs and blindness-avoidance costs and to act on that analysis once it is made, thereby assigning a compensable "right" to the other party.⁴⁰ Whether there is a right to uninterrupted vision or a right to enjoy a technological light-show thus depends, in the world of Coase and Calabresi, on which assignment of rights turns out to be *most efficient in terms of the common denominator of net total wealth*. Of course, once all rights have been assigned on this basis, we must examine the resulting *distribution of wealth*; but to whatever extent we regard the overall distribution as unjust, we need only employ taxes and subsidies to transfer "lump sums"

37. Coase, *The Problem of Social Cost*, 3 J. LAW & ECON. 1 (1960).

38. G. CALABRESI, *THE COSTS OF ACCIDENTS* (1970).

39. That is, an outcome from which no imaginable change would improve the welfare of some persons without reducing the welfare of anyone.

40. See, e.g., Calabresi & Hirschhoff, *Toward a Test for Strict Liability in Torts*, 81 YALE L.J. 1055, 1060 (1972); Calabresi & Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972).

of cash so as to yield a just pattern.

One major difficulty with this approach is that it assumes a principle of distributive justice that looks to the *pattern of end results* rather than to the *process* that generated them. In this respect, the approach shares a failing common not only to virtually all applications of policy-analytic methods,⁴¹ but also to much of contemporary moral theory.⁴² But the difficulty of greatest interest at this point is that the Coase-Calabresi approach overlooks the structural complexity implicit in the problem of assigning rights when it effectively reduces that problem to one of maximizing net total welfare. It is entirely plausible, for example, that some or all of the individuals in *X* and *Y* would insist on a certain minimal quantity and quality of eyesight *as a matter of right* before they would voluntarily exchange any part of their opportunity to see for *any* quantity of any other good, and that our concepts of social justice would and should respect such insistence. If this is so with regard to certain "rights," then it would seem that one could not successfully assign the rights in question so as to maximize efficiency while relying on lump sum transfers to achieve a proper distribution of wealth, for the very concept of a proper distribution would then have to be defined, not with respect to the single homogeneous entity called "wealth," but *with respect to the enjoyment and recognition of these rights as such*. The obvious response is that, if this is in fact the case, then efficiency will dictate assigning the rights *ab initio* to those who express this sort of "discontinuous" preference for such rights (for assigning the rights otherwise would lead to inefficient attempts to bribe the holders of the rights not to exercise them). But then the analytic effort turns out to be a partially trivial exercise,⁴³ obscuring the factors that are really at work in generating underlying feelings as to what rights should exist. And in the end the analytic approach proves to be self-defeating and indeed wrongheaded even if it assigns rights in accord with those underlying feelings, for being "assigned" a right *on efficiency grounds* fails to satisfy the particular needs that can be met only by a shared social and legal understanding that the right belongs to the individual because the capacity and opportunity it embodies is organically and historically a part of the person that he is and *not* for any purely contin-

41. See Pt. III B *infra*.

42. See *Policy Science*, *supra* note 26, at 79-83.

43. That is, the proper allocation of rights turns out, on the stated hypotheses, to be determined in an important range of cases by the structure of certain initial preference orderings rather than by any nice calculus of costs and benefits or by any estimate of the relative accuracy with which various parties can compute them.

gent and essentially managerial reason.⁴⁴

What all of this demonstrates is that the reductionist tendency of policy-analytic methods—their tendency to overlook complex structures (such as the structure of preference orderings that reflect concern for *rights as such* and not merely for aggregate welfare) and soft variables (such as the variable represented by the socially articulated and communally accepted *basis* on which a right is recognized)—can interfere seriously with the validity of analytic conclusions on important matters of policy. This failing, needless to say, is particularly troublesome for any serious effort to apply policy science techniques to the very problems most central to environmental planning and technological development—problems that are characteristically beset with structural complexities (in such basic notions as ecological balance, for example), and problems that typically touch on concepts which resist reduction to “hard” measures and indices (such as the concept of bodily integrity or that of personal dignity).

To some extent, of course, these problems might be made more tractable by further research in the policy sciences; and it appears that at least some academic and professional analysts have begun to turn their thoughts in this general direction. The tendency is an encouraging one, but the dual role of analytic techniques as bases for decision and devices of persuasion may impose significant limits on the extent to which one can expect the tools of policy analysis to be stretched to accommodate the sorts of problems discussed here. The most one can conclude for technology assessment is that, in the present state of the “policy science art,” its tools must be applied with great caution and with the broadest possible understanding—far broader than has been common to date—of the kinds of distortions that those tools create and will continue to create for the foreseeable future.

B. COLLAPSING PROCESS

Even more fundamental, perhaps, than the tendency of the policy sci-

44. See *Policy Science*, *supra* note 26 at 86-89, for a fuller development of this general argument. Perhaps its most paradoxical implication is that no adequate conception of personal “rights” is possible within a wholly individualistic, as opposed to an at least partially communitarian, frame of reference. This is so because, although the essence of a “right” is its independence of what the community’s material needs might be, the very conception of “rights” entails a communally shared acceptance of the non-contingent basis on which they are recognized. Cf. *id.* at 101, 101 n.99. A corollary of the argument is that no wholly instrumental conception of rights as means to various ends can fully capture what the notion signifies. Cf. text accompanying notes 59-84, 116-24 *infra*.

ences to reduce complex structures and dwarf soft variables, has been their almost universal tendency to focus on "outcomes," "impacts," "end results," and the like, while largely ignoring—or relegating to the realm of politics—the questions of process that bear not on *where one ends up* but on *how one gets there*. In most areas of human endeavor—from performing a symphony to orchestrating a society—the processes and rules that constitute the enterprise and define the roles played by its participants matter quite apart from any identifiable "end state" that is ultimately produced.⁴⁵ Indeed, in many cases it is the process itself that matters most to those who take part in it. By focusing all but exclusively on how to optimize some externally defined end state, policy-analytic methods distort thought, and sometimes action, to whatever extent process makes—or *ought* to make—an independent difference.

It may be fairly obvious that the realm of activities or processes engaged in for their own sake rather than as means to some extrinsic end includes instances drawn from the arts (*e.g.*, the performance of a ballet) and from legal procedure (*e.g.*, parts of the conduct of a trial).⁴⁶ What might seem less obvious is that this realm also includes important instances drawn from the making of public policy—both in general, and in particular as it shapes technological development. Thus, for example, even if the economic rationale for making technological enterprises "internalize" their costs proves to be unconvincing in terms of the likely end results (the pattern of resulting development and the economic incidence of its effects), there might well remain important reasons to give an individual a formal role in the legal process that determines whether a technological development affecting him may proceed and, if it may, on what economic terms. To have been accorded an opportunity to take part in that determination, even if only by presenting one's case to a judicial arbiter, has value in itself as an affirmation of the litigant's right not to be treated as merely a passive object of another's technological strategy, too ignorant or uncomprehending even to take part in its formation.⁴⁷ So too it may be that the most crucial dimensions of a particular technology's introduction into, and integration with, a society (for instance, the integration of computerized information networks) will relate less to the "impacts" of the technology

45. See *Policy Science*, *supra* note 26, at 83. See also C. FRIED, *AN ANATOMY OF VALUES* (1970).

46. See *Trial by Mathematics*, *supra* note 34, at 1368-76, 1381-83, 1389-92.

47. See Tribe, *Towards a New Technological Ethic: The Role of Legal Liability*, 21 *IMPACT OF SCIENCE ON SOCIETY* 215, 221 (1971). See also Carroll, *Participatory Technology*, 171 *SCIENCE* 647 (1971).

itself than to the ways in which—the *processes* through which—individuals and communities interact with the evolving structures that the technology defines as it develops and is diffused.⁴⁸ It seems, therefore, that the characteristic end-result orientation of policy-analytic methods currently renders them inadequate to many problem-solving tasks with respect to environmental planning and technology, as well as to tasks in areas more obviously charged with significant procedural dimensions.

But here again, as in the case of the critique in the preceding section, my argument might be said to show simply that the policy sciences should focus more squarely on process, and that policy-analytic theory and method should begin to concern themselves more centrally with the optimization of specifically "procedural" or "processual" values rather than limiting themselves exclusively to extrinsic outcome-optimization.⁴⁹ In other words, one might conclude from the current paucity of policy-analytic attention to process that a *proper* specification of "outcomes" or "results" would in many instances incorporate references to "processual" considerations within the "objective function"⁵⁰ being optimized. There is, after all, no inherent obstacle to formulating an objective function in terms of weighted attributes that include terms referring to process as well as terms referring to end result.⁵¹ Moreover,

48. See, e.g., TECHNOLOGY ASSESSMENT REPORT, *supra* note 9, at 16-17, 125, 127-28, 138.

49. I note here that the policy-analysis literature occasionally adverts to the need to consider process as such (see, e.g., Hinrichs, *supra* note 28, at 13) and that scholars of political economy have turned increasingly to a consideration of voting schemes. See, e.g., Zeckhauser, Voting Systems, Honest Preferences and Pareto Optimality, Discussion Paper No. 7, Public Policy Program, Kennedy School of Government, Harvard University (June, 1972). But the tendency of policy analysis *in practice* is usually to overlook process altogether, occasionally to treat it as important but unanalyzable (viewing it as a legal or political "given" or "constraint"), and sometimes (rarely) to analyze it—but, even then, only in terms of the eventual pattern of end results it is likely to produce (as a market process might, e.g., produce efficient resource allocation).

50. An "objective function," useful primarily as a conceptual device rather than operationally in all but the simplest problems, is a rule that associates with each possible outcome of a decision problem a single mathematically determined value by means of which it may be compared with any other outcome. The complexity of the objective function depends upon the kind of policy analysis undertaken. For a cost-benefit analysis, the function may be of the apparently simple form: maximize "benefits" minus "costs." For a linear programming problem, the general form of the objective function is $W_1X_1 + W_2X_2 + \dots + W_nX_n = Z$, where Z is the value to be maximized, X_1, X_2, \dots, X_n are the relevant attributes, and W_1, W_2, \dots, W_n are the "weights" assigned to each. See generally G. DANTZIG, LINEAR PROGRAMMING AND EXTENSIONS 61 (1963).

51. Thus, X_1 and X_2 (*supra* note 50) might be measures of fair notice and full consultation, respectively, while X_3, \dots, X_n might all represent such end-result attri-

constraints can surely be formulated in terms of unacceptable processes just as they can be expressed in terms of unacceptable outcomes.⁵² Indeed, on one quite plausible view of the matter, there *are* no "end" results but only sequences of events lying on a continuum over time, with no sharp division between process and outcome. Finally, it is not clear why processes or means should be regarded as different in *kind* from outcomes or ends.⁵³ For all of these reasons, no attempt to show policy-analytic methods inherently incapable of illuminating questions of process is likely to be successful. Without here dismissing the rather special difficulties that arise when analytic techniques are turned directly to processes of choice and interaction as such,⁵⁴ one would at least surmise that much could be learned in general, and for technology assessment in particular, from attempts to extend policy analysis to this sphere.

IV. THE OUTER LIMITS OF ANALYTIC METHODS

We have thus far considered the respects in which policy-analytic methods are currently flawed and in need of refinement. If one asks, however, what tasks such methods (and hence modes of technology assessment or environmental planning cast in their mold) inherently *cannot* be stretched to perform, one puts a more elusive question.

butes as dollar cost, some measure of distributional equality, the number of lives saved, and so on. The obvious difficulty of assigning the "weights" W_1, W_2, \dots, W_n in such a case could, however, prove insurmountable in light of the pressure, noted above in Pt. A, to focus on attributes that can be rendered *commensurable* in some convincing way.

52. Typically (to continue with the objective function described in note 50 *supra*) the task would be to maximize Z subject to constraints of the form $X_1 \geq 0, X_2 \geq 0, \dots, X_n \geq 0$, and $A_1X_1 + A_2X_2 + \dots + A_nX_n = 0, B_1X_1 + B_2X_2 + \dots + B_nX_n = 0$, etc. If some of the X_i attributes refer to process, then a number of the constraints might represent outer limits of procedural acceptability.

53. Cf. notes 75-76 and accompanying text *infra*.

54. I have in mind particularly the problem of self-reference that greatly complicates any attempt to apply analytic methods to the design of a decisional process: in any such attempt, the methods so applied must become part of the process they have designed. See *Policy Science*, *supra* note 26, at 83. Moreover, it may be that some "processual" values are destroyed or at least distorted by the very *process* of being reduced to purely instrumental status, much as "rights" are flattened by any such treatment. Cf. note 44 and accompanying text *supra*. And, in any event, it is obviously more than an easily reversible accident of intellectual history that analytic methods have only rarely addressed problems of process and particularly procedural problems of how to resolve conflicts of value. Regarding such problems as almost immediately raising "political" questions of ultimate ends, and viewing their own role as essentially "technical" or "managerial," policy analysts in the United States have by and large remained on the sociologically predictable side of the modern state's disjunction between administration and politics.

A number of scholars have suggested that the ultimate boundary of analytic method lies along the division between "work" (the purposive, rational realization of defined goals under given conditions) and "interaction" (communicative or symbolic behavior understandable only in terms of mutually recognized reciprocal expectations),⁵⁵ or (equivalently) between "task" and "gesture."⁵⁶ Their argument is essentially that an activity pursued in order to *express* some value or attitude cannot be analyzed in the way one might analyze an activity pursued to *achieve* some goal or objective; only the latter can properly be evaluated or derived through "technical" modes of thought calculated to match means to ends. But this argument is closely analogous to the assertion that analytic techniques cannot illuminate choices of *process* as distinct from choices of *outcome*, an assertion we rejected earlier. Just as there seems no intrinsic reason why the analyst's specification of the desired outcome or end cannot be made to incorporate various desired attributes of the procedure or means by which decisions are to be reached in a given area, so too there seems no inherent reason why the analyst's description of the "work" to be done or the "task" to be achieved cannot include certain valued attributes of the action viewed as "interaction" or "gesture." For example, if, as has been perceptively suggested, man wishes not only to bend the environment to his tangible needs but also "to express his kinship with and his relation to nature or that which lies behind and animates nature,"⁵⁷ then one must ask: why cannot the analyst rank alternative environmental policies in terms of their impact on this expressive desire as well as in terms of their more tangible effects? The answer is that the analyst probably *can* do just that.⁵⁸ Thus the suggested distinction between "work" (or "task") and "interaction" (or "gesture") does not appear to locate the limits of analytic methods.

A related distinction, however, comes somewhat closer to locating those limits. I suggested in an earlier article⁵⁹ that personal and social choices serve not merely to implement "given" systems of values, but also to define, and sometimes to reshape, the values—*indeed the very identity*—of the choosing individual or community. The decision-maker

55. See, e.g., J. HABERMAS, TOWARD A RATIONAL SOCIETY 90-92 (J. Shapiro, transl. 1971).

56. See, e.g., T. O'DEA, SOCIOLOGY AND THE STUDY OF RELIGION 275-77 (1970) [hereinafter cited as O'DEA]. Cf. T. PARSONS, SOCIETIES: EVOLUTIONARY AND COMPARATIVE PERSPECTIVES (1966).

57. O'DEA, *supra* note 56, at 277.

58. This statement is subject to the qualifications noted in note 54 *supra*.

59. *Policy Science*, *supra* note 26, at 99.

chooses not merely how to achieve his ends but what they are to be and who he is to become. As I shall shortly argue, policy-analytic methods, and indeed *all* instrumental techniques, fail to be illuminating to the precise extent that a choice is of this latter sort.⁶⁰

But it is important first to be clear about what the suggested distinction with respect to human choice does *not* mean. It should not be confused, for example, with what John Stuart Mill had in mind in his essay on Bentham when he observed that the principle of acting so as to maximize personal interest or utility cannot aid decision-makers in the formation of their own characters but can only “teach the means of organizing and regulating the . . . *business* part of . . . social arrangements.”⁶¹ Mill’s notion was that human behavior can be divided into the self-forming or self-educating type, as to which interest-maximizing offers no assistance, and the operational type, as to which interest-maximizing is perfectly appropriate and fully adequate.⁶² But this conception presupposes a compartmentalization of behavior that belies reality. For virtually every human action, it seems to me, is at once both operational (or “instrumental”) *and* self-forming (or “constitutive”). What I have in mind, therefore, is not a division of conduct into two distinct categories but a recognition of the dual character of *all* conduct and a realization that only *part* of any action’s character can ever be illuminated by the methods of instrumental rationality.

With Mill, one can and indeed should “have a large tolerance for one-eyed men, provided their one eye is a penetrating one.”⁶³ But one must also realize with Mill that a constricted field of vision should not be confused with the full horizon. The methods of the policy sciences—and those of instrumental thought generally—gaze with one eye into human choice, bringing into focus the impact of such choice in terms of pre-existing goals and ends. But instrumental methods do not peer at all into that dimension of human choice which permits the simul-

60. Analytic methods might, of course, be used to illuminate the interplay between ends and means, establishing more precisely the entailments of a given end by exploring the means its attainment would demand. Moreover, analysis can certainly shed light on how various ends or values relate to one another by uncovering intuitively obscure incompatibilities or reinforcing features. However, nothing like the techniques of policy analysis could enable one to choose one’s ends or values; all such techniques can do is help one to attain ends or values otherwise chosen.

61. JOHN STUART MILL ON BENTHAM AND COLERIDGE 73 (F. Leavis ed. 1950) [hereinafter cited as MILL ON BENTHAM AND COLERIDGE].

62. I am indebted to Duncan Kennedy for helping to clarify my understanding of Mill’s precise conception in contrast to my own.

63. MILL ON BENTHAM AND COLERIDGE, *supra* note 61, at 65.

taneous transformation of the system of ends that characterizes the chooser, for *instrumental methods, by their very definition, cannot address the question of what the chooser's ultimate system of ends should be.*

It is traditionally assumed that this is not really a limitation inasmuch as no rational answer to any such question is possible. Policy analysts, for example, have frequently supposed that their necessarily instrumental techniques encompass the *whole* of rationality, believing that the specification of goals, values, or ends must ultimately rest on logically arbitrary (if physiologically or socially conditioned) expressions of will or desire as opposed to acts of reason and understanding. The view that this must be so is, of course, a venerable one. It was, after all, Hume who said that "reason is, and ought only to be the slave of the passions"⁶⁴ Illustrative of how deeply ingrained this belief has become is the tendency of even the most vocally anti-technocratic critics to assume that goals and values must be viewed as exogenous inputs to be "fed into the decision-making process"⁶⁵ as the irreducibly subjective grist for the mill of rational choice. When President Nixon saw a need for the country to address itself "to . . . what kind of a nation we want to be" and responded to this need by establishing "a small, highly technical staff, made up of experts in the collection, correlation, and processing of data relating to social needs,"⁶⁶ his strategy was criticized⁶⁷ as bearing "the unmistakable imprint of the technocratic mentality."⁶⁸ But all the critic could offer as an alternative were "grass roots organisms for expressing the will of large numbers of hitherto unconsulted people"⁶⁹ to hold "a continuing plebiscite on the future,"⁷⁰ on the evident premise that deciding what our ends should be is simply a matter of finding out what people *want*. Under this view they should, of course, decide what they want in light of "data on the social and economic costs of various goals,"⁷¹ including the best available forecasts of how alternative technologies, by

64. D. HUME, A TREATISE OF HUMAN NATURE bk. II, pt. 3, § iii.

65. Toffler, *Value Impact Forecaster—A Profession of the Future*, in VALUES AND THE FUTURE 3 (K. Baier & N. Rescher eds. 1969).

66. Statement of President Nixon Upon Announcing the Establishment of the National Goals Research Staff Within the White House, July 13, 1969, in REPORT OF THE NATIONAL GOALS RESEARCH STAFF, TOWARD BALANCED GROWTH: QUANTITY WITH QUALITY 221 (1970).

67. With some justification, to be sure.

68. A. TOFFLER, FUTURE SHOCK 418 (1970).

69. *Id.* at 424.

70. *Id.* at 422.

71. *Id.* at 425.

changing the costs and benefits associated with the realization of existing goals and values, will lead to the "upgrading" of some values and the "downgrading" of others.⁷² But "values" themselves remain essentially arbitrary, albeit environmentally influenced, expressions of personal tastes or preferences at any given time⁷³—variables to be discerned, predicted,⁷⁴ and cranked into the calculus of choice according to whatever scheme one favors for combining people's individual wants to obtain societal decisions.

This view that values and ends are reducible to logically arbitrary expressions of will or desire proves to be profoundly unsatisfactory for a variety of reasons, not the least of which is the fact that anyone who accepts it must regard every statement about how society "should" be organized or how individual wants "should" be aggregated as merely expressive of the speaker's subjective preferences.⁷⁵ Moreover, no system of thought that takes values and ends as externally "given" and purports only to assess the comparative efficacy of alternative means can offer a satisfactory way of evaluating actions insofar as they are pursued as ends, or insofar as their consequences include the alteration of the ultimate ends sought by various persons in the society.⁷⁶ To be sure, one

72. See, e.g., Rescher, *What is Value Change?*, in *VALUES AND THE FUTURE* 68-109 (K. Baier & N. Rescher eds. 1969); Mesthene, *How Technology Will Shape the Future*, 161 *SCIENCE* 3837 (1968).

73. See Arrow, *Public and Private Values*, in *HUMAN VALUES AND ECONOMIC POLICY* 4 (S. Hooke ed. 1967).

74. In this frame of reference, we must predict what values a person or group of people will hold at time $t+1$ as a result of an action A taken at time t , in order to evaluate the desirability of A from the person's or the group's perspective. See, e.g., Ikle, *Can Social Predictions be Evaluated*, 96 *DAEDALUS* 747, 754 (1967). As Mill put a similar point, one cannot "judge in what manner many an action will affect even the worldly interests of ourselves or others, unless we take in, as part of the question, its influence on the regulation of our, or their, affections and desires." *MILL ON BENTHAM AND COLERIDGE*, *supra* note 61, at 71.

75. It is beyond the scope of this Article to explore systematically the sources and significance of the dichotomy between fact and value, and that between reason and will, on which this mode of thought obviously rests. Various aspects of these dichotomies are discussed in *Policy Science*, *supra* note 26, at 79, 79 n.27, 81, 81 n.37, 82, 82 n.38, 100, 100 n.95, 106. An elaborate and exceptionally illuminating study of these dichotomies and their connections with the other premises of liberal theory in politics, psychology, and epistemology is now being undertaken by my colleague Roberto Unger. It may be that the tendency to conceive the natural order of "fact" and "reality" as value-free (and the correlative tendency to treat the realm of values as beyond the reach of scientific discourse) was itself the result of a value-laden decision: the decision to maximize, through a science bent to this purpose, the power of man over his environment. See M. SCHELER, *DIE WISSENFORMEN UND DIE GESELLSCHAFT* 122 n.2 (2d ed. 1960), transl. in W. LEISS, *THE DOMINATION OF NATURE* 109 (1972).

76. A long-standing failing of welfare economics has been to treat actions as

can insist on evaluating all possible states of affairs in terms of the starting criteria of whichever persons one thinks relevant.⁷⁷ But the decision of *whose* criteria to treat as controlling will remain intractable, and even if only a single individual is involved, it will sometimes be that individual's own *ultimate* criteria—the underlying moral concepts that give shape to human existence and choice—that are at stake. To whatever degree this is the case, it will seem indefensibly arbitrary to prefer one conception or set of criteria to another simply because it came first in time. But, absent such an arbitrary rule, how is a person to decide whether it would be “better” to hold the basic conceptions that identify him at the moment or to be guided by a wholly different set of ideas and ends?

I am not prepared to concede in such circumstances, simply because means-ends rationality can offer no further help, that reason *itself* has exhausted its relevance to the problem of choice, although one is certainly tempted to reach such a conclusion. For example, James March contends,⁷⁸ as I have, that contemporary models of choice in decision theory and related fields mistakenly “assume actors with pre-existent values”⁷⁹ and thereby fail to address the fluidity of goals over time—a crucial omission when the decision-maker either has no de-

not having such consequences even when the evidence strongly indicates that they *do*—probably because of an underlying assumption that comparisons are possible only in terms of a set of ends taken as *fixed*. See, e.g., the statement of Herbert M. Gintis that, at least in the educational system, “taste and personality are . . . developed as part of the economic activities about which social policy is to be made,” so that “the main theorems of welfare economics, being based on the independence of individual preferences from the structure of economic institutions . . . fail.” Gintis, *Education, Technology, and the Characteristics of Worker Productivity*, 61 AM. ECON. REV. 266, 267 (1971). See also Gintis, *A Radical Analysis of Welfare Economics and Individual Development*, 86 Q. J. ECON. 572 (1972).

77. See, e.g., the attempt to subject each value “to an evaluation procedure of the cost-benefit type familiar from economic analysis” by making a “balance sheet of (1) the balance of benefits . . . inherent in its realization, as contrasted with (2) the various sorts of costs that would be entailed by the endeavor to bring this realization about.” Rescher, *What is Value Change?*, in *VALUES AND THE FUTURE* 79 (K. Baier & N. Rescher eds. 1969). This undertaking makes sense only if one assumes that some underlying reference-frame for defining and measuring costs and benefits remains invariant as various actions alter the values being assessed. Economists studying the problem of changing preferences tend to assume precisely this—namely, that the individual possesses an *underlying* set of values or “metapreferences” that remains invariant throughout. See, e.g., Harsanyi, *Welfare Economics of Variable Tastes*, 21 REV. ECON. STUD. 204, 207 (1953-54) (underlying values treated implicitly as reducible to an invariant form of “educated” hedonism); Von Weizsacker, *Notes on Endogenous Change of Tastes*, 3 J. ECON. THEORY 345, 361, 371 (1971).

78. March, *Model Bias in Social Action* (Stanford University Program in the Politics and Economics of Education, Occasional Paper No. 72-5).

79. *Id.* at 13.

finer goal or is unsure that his present set of values is the set in terms of which he wants to act. But March goes on to assert that acting so as to discover, define, or create new goals, as distinct from acting so as to achieve pre-existing ones, must amount to acting for "no good reason."⁸⁰ Accordingly, his prescription in the vital realm of goal-definition is for what he calls a "technology of foolishness,"⁸¹ a playful irrationality through which decision-makers can "act before they think"⁸² so as to escape the narrow confines of their initial sets of goals and move beyond the reasoned implementation of those goals. March thereby assumes the very thing that the technocratic decisional models he criticizes likewise take for granted: the inherently nonrational, subjective, and ultimately arbitrary character of values and of choices among them. Thus, despite his observation at one point⁸³ that the traditional conception of values and goals displays a "relativist bias" in its "belief that preferences need to be treated as exogenous primitives, not susceptible to normative evaluation," March appears ultimately to embrace that view himself.

It may be that March means only to argue that having a "good reason" or a "rational basis" for any choice entails justifying the choice in terms of its tendency to advance some desired end, so that any choice among values or ends, unless it served simply as a means to some still higher-order end, would by definition be a choice made for "no good reason." This argument would, of course, reduce all of "reason" to what I have called "instrumental rationality." The fallacy of the argument lies in its assumed equation between my having a "good reason" to do *X* and my reasonably believing that, if I do *X*, some desired state of affairs (apart from *X* itself) is more likely to eventuate than if I do not do *X*. This equation seems to me a dubious one at best. Consider, for example, the statement that *X* "ought" to be done because it is implied as a special case of a general proposition included in a moral theory that I accept as right. Is this not a "good reason" to do *X*, despite the fact that it does not argue for *X* on the ground that *X* will instrumentally tend to bring about a desired end? To be sure, I might quite properly be pressed first, to state how I know that *X* is implied by my moral theory; and second, to explain why I regard that theory as correct. But as to the first, reasoning from universal propositions to particular applications is at least as familiar as

80. *Id.* at 18, 20.

81. *Id.* at 27.

82. *Id.* at 18.

83. *Id.* at 8.

reasoning from ends to means. And, as to the second, there are many modes of moral justification. To justify a theory, one need not invariably show that it serves some higher-order end, which in turn serves an end of still higher order, proceeding in this way until one finally arrives at an arbitrary assertion of subjective will that cannot be justified by any form of reason. Indeed, even one who concludes that moral discourse can never be purely objective and wholly impersonal has not thereby excluded the possibility of reasoned choice among ultimate values. For just as, in factual discourse, the failure to achieve total objectivity and undoubted neutrality need not render all conclusions arbitrary or reason irrelevant, so too the absence of an impersonal framework of guaranteed objectivity in the moral realm need not mean that a choice of one ultimate value over another must be no more than a wholly arbitrary expression of desire.⁸⁴ One should at least find it imaginable, therefore, that a choice of one ultimate value, or system of values, over another might be made on reasoned grounds even though not in instrumental pursuit of any higher end.

But what I have to say here does not in fact *depend* upon the hope that something properly called "reason" can unlock the mystery of how to choose one's ends. My point thus far is simply that the mystery is unavoidable insofar as the question posed is what those ends should be.⁸⁵ And that will be the question asked with increasing frequency during the next half-century, for the most important categories of technological change in the coming decades are likely to call for choices which dramatically affect what a person *is* as well as what he *does* and choices which quite conspicuously *alter*, and do not merely *implement*, the values of the societies in which such choices are made.⁸⁶ It may also be surmised that in the formation of policy with respect to environment, many if not most of the crucial choices will be ones that *establish*, and do not merely *act upon*, society's values with respect to nature and wilderness.

84. Denying the doctrine of the wholly subjective and arbitrary character of values need not amount to embracing the converse doctrine that values are somehow "objective"; more plausibly, it would amount to accepting a view in which facts and values (reason and will, means and ends) are seen not as radically opposed but as ultimately united in a concept transcending them both, one that is *neither* wholly personal and subjective *nor* wholly impersonal and objective. See *Policy Science*, *supra* note 26, at 77-78, 78 n.25.

85. Ultimately, however, I will be forced to conclude that unless the choice of ends is conceived as in some sense capable of direction by human reason, there can be no satisfactory bridging of the man-machine discontinuity. See note 118 and accompanying text *infra*.

86. See Tribe, *Legal Frameworks for the Assessment and Control of Technology*, 9 MINERVA 243, 254 (1971) [hereinafter cited as *Legal Frameworks*].

It is at this juncture that the conceptualization of technology assessment and environmental planning as forms of applied policy analysis *and nothing more* becomes most debilitating. For if policy-analytic methods (and indeed *all* instrumental methods) simply cannot address the question of what one's ultimate ends and values *ought to be*, then technology assessment and environmental analysis conceived as instances of policy science will either have to be silent as to an increasingly significant range of problems that both disciplines should be called upon to illuminate or will mistakenly treat the choice of ultimate ends as though that task were really one calling only for the selection of means to the attainment of ends already given.

Part V of this Article develops and advances these themes in several illustrative technological contexts, returning at the end to the problem of the fourth discontinuity and its connection with the limits of instrumental thought.

V. CONSTITUTIVE RATIONALITY: TECHNOLOGIES AND ENDS

A. WHEN TECHNOLOGIES ARE ENDS

So long as the problem of assessing and choosing among possible directions of technological change is perceived wholly in terms of selecting technical means so as to optimize some appropriate mix of extrinsic ends, many of the deepest wellsprings of technological development will go unnoticed, greatly complicating the problem of intelligent social control. Any sensitive examination of the history of technology will reveal that man invents and produces tools not only to serve his other ends but often simply for the joy of invention, of making, of mastery.⁸⁷ Moreover, this phenomenon is not confined to the remote past; the aeronautical engineer's contemporary fascination with supersonic transport, for example, is best understood as an instance of technology pursued largely for its own sake.⁸⁸

The technological impulse, closely akin to that of art,⁸⁹ must be comprehended if it is to be channeled. Whereas an invariable view of technologies as means rather than ends might lead to the alteration of

87. See, e.g., the illustrations in Daedalus, *Pure Technology*, TECH. REV. 38-45 (June 1970).

88. See TECHNOLOGY ASSESSMENT REPORT, *supra* note 9, at 56.

89. See Schwitzgebel, *Aesthetic Directions for Technology*, 53 SOUNDINGS 293 (1970); Smith, *Art, Technology and Science: Notes on Their Historical Interaction*, 11 TECHNOLOGY AND CULTURE 493 (1970).

market incentives as the most basic approach to directing technology,⁹⁰ a view of technologies as ends might lead more often to the creation of alternative forms for expressing the impulse that animates such projects as the SST. Alternatively, a clearer recognition of the non-instrumental drives that certain enterprises express might lead in some instances to a conviction that the drives themselves are unworthy and ought not to be indulged. The now familiar (and obviously at times exaggerated) notion, for example, that at least some acts of environmental degradation might express an urge to subjugate the earth rather than merely reflecting a calculated means of producing some independent good could well lead, once assessment is freed of its instrumentalist moorings, to quite direct, and perhaps quite useful, dialogue about the sources of the urge to control and the ways of moderating or even transcending it over time.⁹¹ But it is not enough, it seems to me, to dwell in speculative essays on such possibilities. Until one treats them with respect as conceivably leading to real strategies for action, they are unlikely to make much difference; and treating them in this way may require that one abandon any equation between all of reason, on the one hand, and instrumental rationality, on the other.

B. WHEN TECHNOLOGIES SHAPE ENDS

More pervasive than the realm of technologies pursued as ends is that of technologies which, although pursued largely as means, have the effect of significantly altering the ends—and indeed the basic character—of the individuals and the communities that choose them. Should certain techniques of genetic engineering, for example, be developed? Should research into particular methods of neurological manipulation, to pose another illustration, be publicly subsidized? Attempting to answer questions of this sort entirely on the basis of instrumental analyses (e.g., "What will be the impact of these choices in terms of the present preferences and values of the affected persons?") is bound to miss the most basic point—which is that the answers to questions of this sort will determine not only the degree to which various currently held values will be advanced or sacrificed but also, and most importantly, the ways in which the character of these values (and of the basic conceptions and modes of thought that underlie them) will themselves be defined over time.

90. But see *Legal Frameworks*, *supra* note 86, at 249-55.

91. See generally W. LEISS, *THE DOMINATION OF NATURE* (1972); White, *The Historical Roots of our Ecologic Crisis*, 155 *SCIENCE* 1203 (1967).

To make the argument more concrete, consider briefly the developing technology of asexual reproduction. The ability of many plants and lower animals to generate new individuals from a single parent is well known. Such reproduction is called asexual because the offspring grows from adult body cells that have resumed their early versatility rather than from the joining of male and female sex cells. An asexually produced individual, commonly called a clone, is an exact genetic copy of its parent since each cell nucleus carries a full replica of the genetic information represented by the parent organism from which the cell is taken. In 1952, investigators at the Institute for Cancer Research in Philadelphia successfully removed the nuclei from mature but unfertilized frog eggs and replaced them with nuclei taken from the tissue cells of other embryos or tadpoles.⁹² In roughly half the cases, the renucleated eggs went on to develop normally, each yielding an exact genetic copy of the frog which had been the source of the donor nucleus.

Although human eggs are much smaller than those of frogs, techniques of cell fusion of the sort required to replicate these results with human specimens are currently being developed as crucial parts of the effort to understand the genetic basis of cancer and the biochemistry of such diseases as cystic fibrosis and multiple sclerosis.⁹³ The perfection of cloning technology for human beings, therefore, might well result from avenues of research not directed at mammalian cloning as such. But the motives for developing cloning technology for human beings are not entirely derivative from such other areas of medical research. In the case of various plants and animals of agricultural value, for example, the benefits of cloning in order to duplicate specimens with particularly desired characteristics are obvious. Moreover, in the case of human beings, the possibility of cloning only healthy, normal adults would provide a method of circumventing the risk of genetic disease contained in the random processes of sexual recombination. Indeed, some have suggested going further still and cloning only individuals thought to be genetically superior, thereby preserving their genotypes undiluted⁹⁴—perhaps “to compensate for the spread of genetic diseases” through “uncontrolled sexual reproduction,” or even “to spe-

92. See Briggs & King, *Transplantation of Living Nuclei From Blastula Cells into Enucleated Frogs' Eggs*, 38 PROC. NAT'L ACAD. SCIENCES 455 (1952).

93. See, e.g., Watson, *Moving Toward the Clonal Man*, 227 THE ATLANTIC, May 1971, at 50, 51-53.

94. See, e.g., Lederberg, *Experimental Genetics and Human Evolution*, 100 AM. NATURALIST 519, 527 (1966).

cialize the capacities of people by cloning" particularly able specimens.⁹⁵ Finally, for purely humane reasons, one might want to make cloning available to couples in which one or both partners are sterile, or couples who would like for some reason to have a child that is a genetic copy of a particular loved or admired person—perhaps another child who had recently died or a relative long deceased but genetically preserved in tissue culture.

The systemic risks inherent in the widespread adoption of cloning and similar techniques (*e.g.*, possible imbalance in numbers of males and females or weakened species adaptability as a result of genetic homogeneity), as well as the physical and psychological risks to cloned individuals if the techniques are to be applied before such dangers as that of gross deformity (not to mention the psychic dislocation of being one's parent's "twin") have been brought within acceptable control, will obviously compel fairly close public regulation of the technology as it evolves. The many converging pressures for its sustained development in a number of countries, however, will probably make asexual human reproduction a reality (albeit a tightly regulated one) in the fairly near future⁹⁶ unless a convincing case is presented for concerted international as well as domestic action to ban its progress altogether.⁹⁷

The beginnings of such a case, at least in the United States, might be based upon the theory that, insofar as cloning and similarly sophisticated biomedical techniques become readily available, the very impulse to master the forces of nature that gave rise to them will inexorably lead to their overt or subtle employment by the state as devices for strengthening social control over individual aberrations from some posited "ideal" of a docile, healthy, and productive citizenry. Whereas compulsory sterilization of persons deemed inadequate in terms of this "ideal" might have been too blunt an instrument to gain truly widespread acceptance in this country,⁹⁸ the "finer tuning" made possible

95. Fletcher, *Ethical Aspects of Genetic Controls*, 285 NEW ENG. J. MED. 776, 779 (1971).

96. Dr. Leon Kass of the National Academy of Sciences and the National Institutes of Health has predicted that "it may be technically feasible to clone a human being . . . as early as 1980." Kass, *Making Babies—The New Biology and the "Old" Morality*, 26 THE PUBLIC INTEREST 18, 41 (Winter 1972). How accurate this prognosis turns out to be will obviously depend in large measure on how vigorously the relevant avenues of research are pursued.

97. What forms such action might take is beyond the scope of this Article. See generally L. TRIBE, *CHANNELING TECHNOLOGY THROUGH LAW* 155-303 (1973) [hereinafter cited as *CHANNELING TECHNOLOGY THROUGH LAW*].

98. But see *Buck v. Bell*, 274 U.S. 200 (1927) (upholding compulsory steriliza-

by advancing technology, when coupled with the motive to exert control that arguably fuels such advance in the first place, might present coercive options more difficult to resist.⁹⁹

But the mere possibility that, despite our best efforts to contain it, voluntary use will foreshadow state coercion, will be perceived by most as an exceedingly slender reed on which to rest legal opposition to technological development in the area of human reproduction. First of all, such development promises tangible benefits to childless couples, to the genetically disabled, to those who want children but not heterosexual reproduction, and to communities concerned with overpopulation. Second, there is an understandable reluctance to restrict freedom of inquiry and enterprise now in order to avoid speculative restrictions upon other (perhaps less fundamental) forms of freedom later.

Arguments against pursuing avenues of biomedical research likely to perfect cloning or otherwise to yield technical mastery over reproductive processes nonetheless impress one as serious—at least serious enough to justify a deeper search for the sources of the vague unease engendered by currently evolving techniques for manipulating human reproduction. Before proceeding further in any such search, however, I will undertake a brief detour into a different area of contemporary technological development—that of electronic brain stimulation and neurological manipulation generally—to see what light this further example might shed on our general problem.

Electronic stimulation of the brain (E.S.B.) is a technique being developed, primarily by Dr. Jose Delgado of Yale, for isolating and manipulating the electrochemical processes in the brain that neurophysiologists are attempting to associate with mental activity and purposive behavior.¹⁰⁰ The technique employed by Delgado and others is to drill a small hole in the skull of a person or animal, and then to guide electrode shafts (fine stainless steel wires) through the hole to precise brain locations indicated by a detailed stereotaxic map. The tips of the wires

tion of an 18-year-old feeble-minded mother of an illegitimate child); *In re Cavitt*, 182 Neb. 712, 157 N.W.2d 171 (1968) (sustaining compulsory sterilization of a 35-year-old female with eight illegitimate children). See also the Model Eugenical Sterilization Law described in H. LAUGHLIN, *EUGENICAL STERILIZATION IN THE UNITED STATES* 62 (1922).

99. There are potential constitutional obstacles to at least the grosser forms of social control in these domains. E.g., *Griswold v. Connecticut*, 381 U.S. 479 (1965) (invalidating state ban on use of contraceptives); *Roe v. Wade*, 93 S. Ct. 705 (1973) (striking down state ban on early abortions).

100. See generally J. DELGADO, *PHYSICAL CONTROL OF THE MIND* (1969) [hereinafter cited as *PHYSICAL CONTROL OF THE MIND*].

are scraped bare to permit the passage of electric current to or from the area into which they are placed. The other ends of the wires are fastened to a small exterior socket anchored to the skull. Once this operation has been completed, it is an easy matter to connect the wires with an electroencephalogram or other device so as to "plug" the device into the skull and connect it to a receiving, recording, and sending mechanism, with no serious damage to the brain tissue. Moreover, new techniques employing radio waves instead of connecting wires now allow the transmitting apparatus to be concealed beneath the subject's skin, so that no unsightly equipment is visible from outside.

Such electrode implantation obviously provides a rich source of information. It allows the neurologist to record the precise location, frequency, and composition of the electrical patterns in the brain associated with a broad range of nervous disturbances and mental illnesses, from Parkinson's disease to schizophrenia. And it permits the investigator to move from the pathology of neurological malfunction to the clouded realm of human sensation and emotion, inviting him to observe the birth of pain and rage, to explore the origins of fear, and to monitor the electrical discharge that may cause one human being to kill another.

Electrode implantation, however, plainly furnishes more than a source of knowledge and diagnosis. Once the electrical brain patterns associated with various mental processes have been charted, it becomes possible to induce (or at least to activate) whatever patterns are found to be linked with desired mental states in the hope that those states, and the behavioral manifestations they display, will in fact be generated. To this end, the electrode implanted in the brain becomes a receiver as well as a transmitter—and the object of the exercise becomes to manipulate as well as to observe.

Thus, by pushing the right "button", Delgado has learned how to make a monkey turn his head, open or shut his eyes, move his tongue, flex his limbs, yawn, sneeze, or hop. E.S.B. has been used to make some animals increase their food intake ten-fold, to send them into deep sleep, and to snap them awake again. By stimulating the brain's hypothalamic region, E.S.B. has been used to adjust the size of a monkey's eye pupil almost as precisely as one might adjust the lens of a camera. E.S.B. has even been used to evoke remarkably complex and subtle behavioral sequences. Occasionally, it appears, Delgado has found that an animal's voluntary activity can overcome movement electrically invoked. However, this has only occurred at lower levels of inducement,

and by increasing the intensity of stimulation, Delgado has invariably been able to force the subject to respond as directed.

Brain stimulation in humans is less advanced than experimentation on animals, but the results are already revealing. E.S.B. can delay a heartbeat, close an open hand, or bring a word to memory. It has produced such intricate auditory hallucinations as the "hearing" of a piece of music from beginning to end. It has stirred intense feelings of *déjà vu* as subjects have been led to recall vivid details of past experiences—words spoken long ago, sounds of children playing, and cars passing beneath a window. Like Delgado's animals, human subjects have found it impossible to resist the externally triggered "programs" of their own minds. One patient, a psychomotor epileptic, was asked to extend his fingers into an open hand while receiving electrical stimulation of his left parietal cortex, the apparent locus of his brain's program for clenching a fist. Repeatedly, he failed. "I guess, doctor," he said, "your electricity is stronger than my will."¹⁰¹

As in the case of cloning (and genetic "engineering" in general), one obvious fear generated by brain research of the kind Delgado has undertaken—and indeed by brain research generally—is that it will become the basis for large-scale programs of governmental coercion. The involuntary application of E.S.B. and of closely related psychological and chemical behavior-modifying methods have for some time been under active consideration and even occasional use in institutions of confinement across the United States and throughout the world.¹⁰² Yet in this area, as in the area of reproductive technology, the promised benefits seem too clear to warrant opposition solely on the ground of potential future abuse by government or other powerful organizations. Electrode stimulation, or other techniques for neurological manipulation, might one day calm the violence of the pathologically aggressive, depress the appetites of the obese, halt the suffering of the epileptic, and modulate the painful sensations and antisocial actions of persons for whom no currently available alternative seems either as humane or as effective as the techniques that electronics and chemistry might ultimately perfect.

But here again, as in the area of cloning, the sense of unease generated by the technological advances themselves, *even if they are not abused*, seems substantial enough to make one pause. The real

101. Scarf, *Brain Researcher José Delgado Asks "What Kind of Humans Would We Like to Construct?"*, N.Y. Times, Nov. 15, 1970 (Magazine) at 163.

102. See Note, *Conditioning and Other Technologies Used to "Treat?" "Rehabilitate?" "Demolish?" Prisoners and Mental Patients*, 45 S. CAL. L. REV. 616 (1972).

sources and character of such unease, however, will never be fully captured by attempts to identify and balance the impacts of the technologies in question upon the range of "interests" seemingly affected. For it seems to me that more is involved than "scoring" these technologies in terms of *any* set of affected interests, however broadly conceived.

What these two technologies illustratively implicate, each in its own way, is a fundamental threat to the concept and the reality of the human person as a unique and intrinsically valuable entity, conscious of its own being and responsible for its own choices. Cloning a person, beyond denying the resulting individual a *unique* genotype,¹⁰³ denies the individual an *undetermined* genotype (that is, one "determined" by chance) and makes him, at least genetically, the deliberately planned result of another's choice.¹⁰⁴ Similarly, shaping an individual's personality by electrochemical means without the individual's continuing conscious participation makes him, at least neurologically, the equally planned result of a choice for which *the person that he has become* cannot feel fully responsible.¹⁰⁵ Yet one's sense of "selfhood" or "personhood," and the related experience of one's autonomous individuality, may depend, at least in some cultural settings, on the ability to think of oneself as neither fabricated genetically nor programmed neurologically—even by one's former "self."¹⁰⁶

Moreover, as one's most intimate nature as a person—one's genetic basis and neurological identity—becomes increasingly subject to deliberate external manipulation and even prior determination, one's ability to conceive of oneself as a free and rational being entitled to resist various societal claims may gradually weaken and might finally disappear altogether.¹⁰⁷ In a society that came to view its members as just so many

103. Each member of a pair of identical twins, after all, must share a genotype with the other. The threat to *uniqueness* thus seems a manageable one.

104. I develop this point further in my book *CHANNELING TECHNOLOGY THROUGH LAW*, *supra* note 97, at 190. Of course, the sense of uniqueness and that of unplanned identity are vastly more complex than a concern with genotype alone might suggest. But this does not deny the enormous significance of the fact that a person's material being, at least, will have been deliberately and calculatingly matched to a pre-existing model or blueprint rather than representing the unprogrammed result of a human sexual act.

105. Nothing I intend to argue in this area is peculiar to E.S.B. as such; the point I wish to make could be illustrated as well by less obviously "mechanical" intrusions so long as they operate to change human personality in precise and determinate ways that override or circumvent individual will. That Delgado's particular brand of work may prove to be more sensational than seminal is thus of no particular relevance to the argument advanced here.

106. *CHANNELING TECHNOLOGY THROUGH LAW*, *supra* note 97, at 323.

107. *Id.* Studies of human mental development could obviously shed much useful

cells or molecules to be manufactured or rearranged at will, one wonders how easy it would be to recall what all the shouting about "human rights" was supposed to mean.¹⁰⁸

To be sure, some objections of this form can be regarded as merely adding plausibility to the still speculative fear that these technologies will ultimately enhance the dangers of tyrannical government. But it is not so easy to dismiss the underlying proposition that pursuing the technologies in question, for better or for worse, *will profoundly alter what it means to be a human being* and will do so in ways that matter whether or not particular "abuses" ever take place. As one observer so aptly put it, to "lay one's hands on human generation is to take a major step toward making man himself simply another one of the manmade things."¹⁰⁹ And to mechanize through technology¹¹⁰ the formation of human character and personality may make that first major step a truly irreversible one. Nobel Laureate Joshua Lederberg looks forward to the day when our mastery over ourselves as well as our environment will be such that we can do "essentially anything that we care to do in the area of biological engineering."¹¹¹ But does not that dream at least potentially entail the final transformation of man into an object—a thing to be "engineered" according to technical specifications along with the many other products of human ingenuity?¹¹² If, as Marx recognized, man "changes his own nature" by "acting on the external world and changing it,"¹¹³ how much clearer it seems that man changes himself by turning his technology inward in order to achieve the ultimate mastery—mastery over his own evolution as a species and his own development as an individual.

light on this conjecture, but its character is only partly that of an empirical proposition; I believe it rests in part on the structure of the very concepts of freedom, rationality, and personhood.

108. See *id.* at 178. It seems to me no mere coincidence that Jose Delgado, the pioneer of E.S.B., describes "[o]ur living body" as "only a transitory organization of chemical compounds," (PHYSICAL CONTROL OF THE MIND, *supra* note 100, at 23), and that Arthur Kornberg, biochemist and Nobel Laureate in Medicine and Physiology, sees in genetic research the birth of a theme he describes as "the molecular foundations of human nature." See CHANNELING TECHNOLOGY THROUGH LAW, *supra* note 97, at 162.

109. Kass, *Making Babies-The New Biology and the "Old" Morality*, 26 THE PUBLIC INTEREST 18, 49 (Winter 1972).

110. *I.e.*, through any process that is not powerfully mediated by the conscious and intelligent participation of the subject.

111. CHANNELING TECHNOLOGY THROUGH LAW, *supra* note 97, at 170.

112. See Wald, *The Evolution Of Life and the Law*, 19 CASE W. RES. L. REV. 17 (1967) (distinguishing technological from organic design).

113. K. MARX, CAPITAL vol. I, 177 (1961).

What such a change would mean for particular systems of human ends and values is by no means obvious and demands further study; but that it could alter those systems radically seems to me hard to dispute. That a societal choice with respect to technologies responsible for changes this profound ought to address the desirability and moral permissibility of such changes seems equally undeniable.¹¹⁴ At stake are not merely alterations in the "costs" and "benefits" associated with implementing existing preferences and values but alterations in the very structures of human thought and reality on which all value premises and the choices that embody them—all the frames of reference for defining one thing as a "cost" and another as a "benefit"—must ultimately be based. To conceive of the choice as a selection in terms of a "given" value framework thus begs the question presented by the sorts of cases that have been considered here.

Although they may provide particularly dramatic illustrations, the technological developments I have selected for discussion are in no relevant sense unique. The *particular* changes they would work in the character of man are obviously quite special, but that they would significantly alter the identity of any society which chose them does not make these technologies different in kind from many others, past or present.¹¹⁵ One necessary ingredient of a mode of thought fully adequate to the assessment of *any* major technology, therefore, must be a realization that to develop the technology in any given direction is to "remake" its developers and users in a particular way.¹¹⁶ This in turn requires that society not conceive of the choosing individuals and com-

114. I do not pretend to have reached a judgment myself on the merits of the question. The range of options is, of course, very broad; it includes approaches as diverse as selective regulation and anticipatory public education. See generally CHANNELING TECHNOLOGY THROUGH LAW, *supra* note 97.

115. When the first human being took to the air, did the airplane affect only what he could *do*, or did it not also affect his concept—and the reality—of what he *was*? I suspect the correct answer is the latter. At the same time, I recognize that my argument is primarily pertinent to the overall movement of technology, and to certain critical technologies, rather than to most day-to-day incremental changes—which may quite properly be regarded as essentially instrumental.

116. This theme is of course a familiar one in Marxist thought. See, e.g., V. CHILDE, *MAN MAKES HIMSELF* (1936). The usual Marxist analysis is that individuals and societies are transformed by entering into the altered *patterns of production* created by new technologies; the sort of transformation contemplated here includes the latter but may also go deeper, for it may involve a radical reshaping of the constitutive elements (e.g., physical characteristics, mental capacities, ultimate ends and self-conceptions) of human identity itself. Developing a typology of modes, both direct and indirect, through which technologies of various types (e.g., productive, informational, biomedical) can "reconstitute" humanity is beyond the scope of the present Article.

munities as "given," with their identities already defined at the point when choices are to be made; it requires a reciprocity of subject and object in which society conceives of the chooser as fluid and of choices as continually shaping and redefining who and what the chooser is.

Any such conception of the chooser and the nature of choice, however, involves a major difficulty. It is the structure of this difficulty that I believe best illuminates the relationship that is the central topic of this Article—the relationship between transcending instrumental rationality (solving the problem of *means and ends*) and bridging the man-in-machine discontinuity (solving the problem of *subject and object*). The difficulty I have in mind is that any conception in which the choice defines the chooser (the object defines the subject) has a potentially devastating significance for the central ideas of human striving and of personal and communal identity.¹¹⁷ For if subject and object merge so that the individual and the community are themselves "made" in accord with the dictates of an impersonal causality triggered by man's technological choices, have we not already come to the very pass we thought was threatened by cloning and neurological manipulation? Have we not already reached the condition in which man the maker has become man the artifact—the manufactured object of his own technology, trapped in a process he can never hope to transcend? And if the set of ultimate ends that defines a person must be perceived as the shifting product of the instrumental choices to which his subjective desires point from moment to moment, have we not abandoned any integrated notion of the person as a self with a continuing identity over time and any possible conception of persons as selves sharing in a community of ends?¹¹⁸ If this is to be man's bridge across the discontinu-

117. Most of what follows (notes 118-26, 134-36 and accompanying text *infra*) is wholly tentative; it touches matters which I believe to be of the deepest importance, but does so in a way that is still far too sketchy to represent more than preliminary gropings toward a solution.

118. *Continuity over time* requires a unifying thread that the shifting set of momentary wants cannot provide, while *community among persons* demands more than a merely accidental or haphazard coincidence among the ends they individually seek. I am not convinced, however, that the disintegration discussed here must invariably follow as soon as one conceives all choices of ends and values to be arbitrary with respect to the dictates of reason, for such a conception of ends as arbitrary seems at least potentially compatible with a notion of persons as having temporally stable and communally shared identities somehow independent of, and deeper than, the shifting systems of ends toward which they happen to orient themselves from time to time. But whether or not such a notion could be coherently developed, it would certainly collapse as soon as one took the position that persons have *no* fixed identities independent of the ends they choose to pursue—a position we have seen to be required if the constitutive impact of technological choice upon the chooser is not to be disregarded. It is

ity separating him from his machines, the crossing will be perilous indeed.

We would appear to be trapped. Either we remain alienated from our technologies by denying their profoundly formative influence on who and what we are, or we acknowledge this influence and become mere things, lacking distinctive individuality, temporal unity, and social cohesion.¹¹⁹

But the vise may not be shut as tightly as it seems. The key that I suspect can unlock it is the very one that was needed when the limits of instrumental rationality were reached and a way to reason about the choice of ends seemed necessary. *As soon as we can imagine committing ourselves to a system of ends in a manner that is faithful to our individual humanity without being arbitrary, we may thereby have found a satisfactory way to bring both individuality and coherence to the whole of which man and his actions—subject and object—form reciprocally linked parts.* For it is only so long as commitments to ultimate ends are regarded as necessarily arbitrary expressions of personal desire that the sequence of such commitments, *and hence the series of “selves” they generate over time*,¹²⁰ must lack connecting unity, and that the “persons” thus created must lack ultimate community.¹²¹ And it is only if one can conceive of no alternative to arbitrary acts of personal will other than a universal and deterministic form of reason that any unity achieved over time, or any community achieved among persons, must be purchased at the sacrifice of separate and individual humanity, capable of transcending its limitations through history.¹²² But if a person acts upon

therefore the fluid concept of personal identity, which we have seen follows from an attempt to account for the way in which tools “make” their makers, that most clearly forces any notion of ends as inherently arbitrary and voluntaristic to culminate in a disconnected and isolated idea of human identity. To put the matter otherwise, the arbitrariness of ends appears to yield arbitrary and disintegrated persons only if persons are thought to lack any solid “core” *apart* from the ends they seek; thus it is the recognition that technological choice continually remakes the chooser which, by emptying persons of any such solid core, makes it necessary for us to transcend the concept of ends as arbitrary if we are to become a society of persons who cohere over time and share a communal existence.

119. I do not here address the question of precisely why these values in particular should be given the central role which they assume in my argument.

120. See note 118 *supra*.

121. A somewhat parallel point is suggested by Roberto Unger with respect to the “morality of desire” in R. Unger, *Knowledge and Politics: Metaphysical Foundations of the Liberal Doctrine* (unpublished manuscript).

122. Again, the argument in the text is to some degree paralleled by one independently advanced by Unger (*id.*) with respect to the “morality of reason,” which he regards as submerging the self in an “atemporal and universal order” and ignoring its

a body of principles grounded in reason and in shared understandings while still expressing a distinctly personal commitment as he makes choices among technological possibilities and thus among ultimate ends, then—although his ends, his physical nature, and even his self-conception will change over time under the influence of the technologies he chooses—the body of principles to which he adheres may yet define an enduring identity that makes him whole while preserving both his individuality and his commonality. If it is objected that the guiding principles will themselves be in flux, the response must be that they can nonetheless constitute a coherent *system* as they evolve, and that the person's commitment to that system of principles can integrate his individual history over time¹²³ and unite it with a wider human community.

Thus, there appears to exist a complex linkage among three fundamental conceptions: that of the choosing subject as independent of its chosen objects; that of ultimate ends as inevitably subjective and arbitrary; and that of morally significant reason as necessarily universal to all of humanity and invariant throughout history. If the first is abandoned but the second maintained, both personality and community dissolve. If the first is abandoned but the third maintained, neither distinctive individuality nor the striving to transcend existing conditions can have meaning. Yet if the first is *not* abandoned, neither the man-machine discontinuity nor its alienating consequences can be overcome. It would seem that *all three conceptions must therefore be abandoned together*, and replaced by a notion of commitment to a system or systems of principles at once both personal and yet communally shared, both evolving over time and yet shaped by a form of reason.

It will no doubt be clear to all that the intellectual architecture and the social and political preconditions of any such system or systems of principles remain to be elaborated, as do the contents of the underlying conception of commitment and choice on which such systems might be built. But the broad contours of that conception can obviously be sketched in terms of the basic functions it must perform: it must accommodate a fluid and reciprocal notion of personal and communal identity and of the subject-object relationship in which the act shapes the actor

individuality. Unger argues that this is so because any ethic purporting to claim no justification save pure and universal reason (e.g., that of Kant's moral doctrine) withdraws moral significance from whatever desires may be peculiar to a single individual and from whatever ends may be peculiar to a given point in time—the very desires and ends that define the individuality and dynamism of persons.

123. Cf. C. FRIED, *AN ANATOMY OF VALUES* 158-62 (1970); T. NAGEL, *THE POSSIBILITY OF ALTRUISM* 57-76 (1970); J. RAWLS, *A THEORY OF JUSTICE* 560-67 (1971).

no less than the actor chooses the act;¹²⁴ it must encompass a vision of human existence in which wanting and knowing—desire and reason—present integrated facets of a common reality rather than opposing poles of an inexorable dichotomy; and it must embrace an idea of rationality that is more personal and more deeply rooted in the life history of the individual than is true of abstract, universal reason. Once a conception meeting these three demands has been perceived, however dimly, it should be possible—without risking either dehumanization or disintegration—to think of technology assessment not as the essentially mechanical application to tools of the diad consisting of men and values, but rather as the more organic shaping of an inseparable triad consisting of men, tools, and values as the three define and constitute one another over time.

I am, of course, aware that the form of thought which I have argued we should seek may not be within reach in the foreseeable future; many will undoubtedly believe that it is inherently unattainable. But even the most skeptical might, upon reflection, recognize some of its elements within themselves. Imagine asking, for example, "what kind of society do I want this to be," or "what sort of person would I wish to become?" Such questions do not, it seems to me, appear empty or absurd simply because we are not yet in possession of a mode of discourse fully adequate to the task they pose. Notice that questions of this form do not seem "factual" in the sense that their answers might be "objectively" and "impersonally" scored as either "correct" or "incorrect" in light of some external reality. Yet they do not seem to call merely for a report of one's purely "subjective" wants or desires in the sense that questions about one's personal feelings or tastes appear to call merely for that. In thinking about the sort of person one would want to be, or the sort of society one would wish to have, one would not simply consult his "needs" or "impulses" as he might in deciding, for example, whether to eat dinner early or what color shirt to buy.¹²⁵ The process in which one would engage is somehow less arbitrary,¹²⁶ less idiosyncratic, more crea-

124. As Roberto Unger suggested upon reading an earlier draft of this Article, such a notion arises even more naturally when the choosing subject is not an individual but a community and the chosen object is not a personal act but a social one. In both cases, however, it should be noted that the merger of subject and object proposed here is *not* tantamount to a merger of consciousness and being; unless the latter two remain distinct, man becomes a thing incapable of sentient change.

125. I am indebted to Philip Heymann for suggesting this formulation of my argument.

126. The notion of arbitrariness in this context is a complex one. On the most conventional view, "impulses" or "desires" are at the same time morally "arbi-

tive, and more amenable to reflection and persuasion; one could not comfortably place it at either pole of the supposed dichotomy between reason and desire.

Merely performing the thought-experiment sketched above should make somewhat more plausible the notion that the mode of thought I have tried to describe can someday be developed. But even one who continues to doubt the existence of any system of thought that fully performs the tasks I have outlined should recognize that, *whatever* it is a person does when considering what he wants to *be*, the question is different in kind from one that simply asks for a report of his preferences at the moment, and is the sort of question that must be asked when confronting a choice which may importantly alter the chooser's set of preferences or the chooser's basic character.

To illustrate this general theme in a case simpler and more mundane (and perhaps, for that reason, more instructive) than those of cloning and neurological manipulation, consider the situation of a community that must decide whether to build a dam that will yield various economic and recreational benefits while inundating certain wild areas and destroying various animal and bird species. The instrumental mode of thought characteristic of the policy sciences would treat this decision as one calling on the community merely to make a number of trade-offs among the pre-existing interests and values of its inhabitants so as to achieve, within constraints politically derived from those interests and values, some sort of optimal, or at least satisfactory, outcome. In its cruder forms, the analysis might seek to reduce all of the variables to a common denominator and might ignore "soft" variables altogether; but with greater sophistication, it would presumably take account of structural complexities and hard-to-quantify features of the problem, and might even settle for displaying a plurality of utility functions (each corresponding to the impact of the proposed decision on a particular affected interest), rather than attempting in any way to aggregate the decision's various impacts.¹²⁷ Again in its cruder forms, the analysis might overlook the preferences of various community inhabitants toward

trary" (*i.e.*, arbitrary vis-à-vis any moral theory or the dictates of reason) and socially or biologically "caused" (even if by mechanisms not yet understood); indeed, it is in part their physiologically and/or culturally determined character that is often thought to deprive basic wants of intrinsic significance in the moral and rational orders.

127. See Dorfman & Jacoby, *A Model of Public Decisions Illustrated by a Water Pollution Policy Problem*, in *PUBLIC EXPENDITURES AND POLICY ANALYSIS* 173 (R. Haveinam & J. Margolis ed. 1970).

alternative legal and political processes for making the decision; but with greater sophistication, the analysis would hopefully reflect these preferences as faithfully as it would reflect preferences with respect to eventual outcomes and tangible impacts.¹²⁸

What, then, would be left out of the analysis *at its best*? The analysis could help the community draw various inferences from an assessment of how much its inhabitants *do in fact* value birds and other wildlife as compared, say, with boating and other activities; that is, the analysis could spin out the logical and empirical entailments of the value systems with which the community begins. But the analysis could *not* enable the community's inhabitants to think about *what those value systems ought to be*—about the extent to which theirs *should be* a wildlife-valuing community, with all that this might entail for how its members view and value both nature and one another. Yet surely the decision of whether or not to build a dam calls upon the community somehow to address that issue. In choosing whether or what to build—in deciding what technologies to adopt—the community does more than generate a distribution of payoffs and penalties to its members; it also alters irreversibly the experiences available to them (and hence the development of their preferences and consciousness over time) and defines, to a greater or lesser degree, the community's relations with the natural order and its character as a society of persons.¹²⁹

In a conception of “political process” that is rich enough to go beyond merely aggregating what people in fact *want*,¹³⁰ so that it also considers what they *should* value,¹³¹ the task of addressing the issue of what value systems a community ought to embrace would, of course, be a paradigmatically “political” one.¹³² But so long as the conception of politics remains that of a neutral aggregator of conflicting wants, neither politics *nor* analytics can properly confront the issue posed here.

128. *But see* note 54 *supra*.

129. Of course, to whatever extent a given project leaves intact the system of higher-order values in terms of which instrumental choices can be made among all affected lower-order values, analytic methods will continue to be potentially helpful; the discussion in the text applies only to the degree that the community's *ultimate* self-conceptions and criteria of choice are themselves affected by the project in question. *See* note 77 and accompanying text *supra*.

130. *See* text accompanying notes 18 & 63-74 *supra*.

131. Or what they “*want to want*,” which may come to the same thing. *Cf.* Frankfurt, *Freedom of the Will and the Concept of a Person*, 68 J. PHIL. 5, 7-14 (1971).

132. This should not, however, be confused with the view—which I do not hold—that the required process would not be one of *reason*; the very dichotomy between “*reason*” and “*politics*” is one I am not prepared to accept. *See* note 75 and accompanying text *supra*.

Consider, in particular, the question of the animal species affected by the community's choice. Since cost-benefit analyses invariably focus on what values the persons within a decision-making unit attach to the various outcomes, such analyses typically treat non-human life forms as valuable only to the extent that they are caught and killed by fishermen, hunters, and other human predators.¹³³ And certainly, beyond the point at which their exploitation in *some* form can be of value to people, the wildlife inhabitants of a region, in traditional analyses, are paradoxically regarded as wholly without worth. By focusing public discourse and thought not only on how much the community's members presently value the neighboring wildlife but also on how much and in what ways, if at all, such wildlife *should* be valued, the community could well come to conclusions at odds with those indicated by instrumental policy analyses.

If it were to arrive at such conclusions, moreover, it might then seek institutional embodiments (through appointed guardians or trustees, for example) of its felt obligation to treat the life about it with respect.¹³⁴ If the community did formulate such decisional processes, then even on those occasions when the resulting institutions ultimately resolved not to forego certain human opportunities "for nature's sake," the very process of according nature a fraternal rather than an exploited role would shape the community's identity and at least arguably alter its moral character.¹³⁵

VI. CONCLUSIONS

How many choices would in fact yield different outcomes once the second or *constitutive* question were thoughtfully confronted alongside the first or *instrumental* one is, of course, impossible to say. But for at least some decisions—including, I would surmise, most of the decisions that will be remembered as landmarks in technological and environmental history a century hence—the dominant dimension will probably be their impact in reconstituting who we are. As to those decisions, at least, it would be nothing beyond happy coincidence if a purely instrumental analysis alone were to point in the same direction as an assessment consciously addressed to the constitutive question as well.¹³⁶

133. See, e.g., L. JAFFE & L. TRIBE, ENVIRONMENTAL PROTECTION 354-65 (1971).

134. See, e.g., Stone, *Should Trees Have Standing?—Toward Legal Rights For Natural Objects*, 45 S. CAL. L. REV. 450 (1972).

135. See pt. III B *supra*.

136. And in any event, the analyses would differ in *process* even if they happened to converge in *result*.

To be sure, developing the sort of "constitutive rationality" for which this Article ultimately calls is itself a monumental undertaking. Its path already stretches over centuries and includes efforts as diverse and magisterial as those of Aquinas, who sought the answer in divinity, and Hegel, who sought it in history. If a theology suited to our era lay close at hand, the task of "choosing" ends, values, and conceptions of man might seem less inherently voluntaristic, and hence more derivable by processes of reason from a convincing notion of the natural and moral orders as lying on a single continuum.¹³⁷ But so long as Kant's "two reasons" cannot be reunited, and so long as we feel bound by Hume's dictum that no "ought" can ever follow from an "is,"¹³⁸ it will remain difficult to perceive how the proposed extension beyond instrumental rationality should proceed.

Yet we need not define the logic and design the structure of this extended rationality before we recognize how deeply our technological choices define what we become¹³⁹ and hence require us at least to *ask* what we should be. In the interim, of course, we will have to act before answers are available; whatever the broader conception toward which we move, we cannot avoid the necessity of making technological choices in the present. As we make them, this Article can only counsel the most serious efforts to inform such choices with greater foresight,¹⁴⁰

137. Might the gap between these two "orders" not represent a "fifth discontinuity," rather analagous to Husserl's notion of the radical life-crisis that could only be resolved by finding a rational basis for the interaction of the ordinary world of value-laden experience and the abstract world of scientific conceptions? See E. HUSSERL, *THE CRISIS OF EUROPEAN SCIENCES AND TRANSCENDENTAL PHENOMENOLOGY* (D. Carr transl. 1970).

138. See D. HUME, *A TREATISE OF HUMAN NATURE* bk. III, pt. I, § i. For a critique of this position, see, e.g., Black, *The Gap Between "Is" and "Should,"* 73 *PHILOS. REV.* 165 (1964). Cf. notes 75, 84 and accompanying text *supra*.

139. In a word, man may not have to bridge the fifth discontinuity fully before he bridges the fourth.

140. The usefulness of creating sensitive "early warning" systems to illuminate through research the possible second-order consequences of technological change has been amply demonstrated quite apart from the merits or drawbacks of technology assessment conceived as a branch of the policy sciences. See, e.g., *TECHNOLOGY ASSESSMENT REPORT*, *supra* note 9, at 44-52, 99, 140-41. I am indebted to Jerome Wiesner for reminding me of the independent significance of this early warning function. Without in any way disparaging the difficulty or minimizing the value of adequately performing even this relatively modest function of facilitating greater foresight, one must recognize it as significantly less ambitious than the policy-analytic function of guiding "technological change with more timely and comprehensive balancing of total costs against total benefits." *TECHNOLOGY ASSESSMENT REPORT*, *supra* note 9, at 4. See, e.g., Bowers and Frey, *Technology Assessment and Microwave Diodes*, 226 *SCIENTIFIC AM.* 13 (1972). It is only when the proponents of technology assessment ad-

coupled with the caution that comes from remembering that our modes of thought are not yet adequate to the task before us. Thus, if an instrumental analysis in terms of present values indicates only marginal advantage in one choice over another, doubts as to what sorts of values and what sort of society one of the choices would yield, linked with doubts as to whether we *should* become that sort of society (and doubts about how questions like the latter should be approached), might well be given controlling weight.¹⁴¹ But when the instrumental case for taking a particular step without delay seems overwhelming in light of values currently held, a lingering suspicion that such a step *might* shift those values in directions that we *might* deplore if we but saw the moral light cannot justify its indefinite rejection; the alternative view would spell complete—and unthinkable—social paralysis.

My position, therefore, is not that, pending the evolution of a larger conception, the development of technology assessment as instrumental policy analysis should be abandoned or its conclusions ignored, but only that it should always be enriched by attempts, however imperfect, to assess technology in constitutive terms as well. We are not, after all, wholly without intuitions bearing on these constitutive matters; if an individual senses a particular technological prospect as somehow offensive to the essence of humanity, the inchoate apprehension thus expressed ought to be treated not as an immaturity to be overcome¹⁴² but as a potential source of wisdom to be explored.¹⁴³ The belief that there might exist a mode of thought not yet developed which will eventually enable us in some sense to “reason” toward ultimate ends, and the experience of groping toward such a mode of thought, should make it easier to treat such intuitive fragments seriously rather than dismissing them because of their supposed irrationality.¹⁴⁴ And treating them seriously may in

vance a concept this large that they take a step which, as I have tried to show, commits them to an even grander undertaking than they perhaps intended.

141. Cf. the discussions on preserving options and allocating the burden of uncertainty in TECHNOLOGY ASSESSMENT REPORT, *supra* note 9, at 32-39.

142. *Contrast* 225 NATURE 886 (1970) (editorial dismissing lay expressions of terror at “the idea of creating life at man’s will” as “dark and atavistic fears”).

143. See CHANNELING TECHNOLOGY THROUGH LAW, *supra* note 97, at 178. The notion I here advance—that intuitions about the “natural” may yield morally significant guideposts to action—is of course traceable to such moral theories as those of Aristotle and Spinoza, and is incompatible with the sense of an *entirely* open future for the human species. But it need not, I think, degenerate into an entirely closed and deterministic conception of permissible futures. As always, the problem is somehow to achieve integration (here, integration of the “natural” or the “given” with the “desirable” or the “chosen”) without destroying transcendence.

144. I am indebted to Charles Fried for much helpful discussion on this point.

turn contribute toward the ultimate development of the mode of thought we seek.

In the meantime, like sailors who must rebuild their ship on the open sea without yet discerning its ideal design,¹⁴⁵ we must simply do the best we can—realizing always that the best may not be good enough. But if we make no effort to progress, however haltingly, in the direction of a constitutive rationality that will enable us someday to do better, it is hard to see what can prevent technology assessment from remaining purely technological—concerned exclusively with the efficacy of means rather than the desirability and morality of ends. And, if that should come to pass, then the otherwise extravagant notion of technology ruling man by its autonomous imperatives¹⁴⁶ becomes frighteningly plausible as the technical order plunges ahead, remaking man in *no-one's* image.

145. The metaphor is that of Otto Neurath in *Protokollsätze*, 3 ERKENNTNIS 206 (1932). See W. QUINE, *WORD AND OBJECT* ix (1960).

146. See, e.g., J. ELLUL, *THE TECHNOLOGICAL SOCIETY* (J. Wilkinson transl. 1967).

THE FEDERAL POWER COMMISSION AND THE COORDINATION PROBLEM IN THE ELECTRICAL POWER INDUSTRY

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The "energy crisis" has focused public concern on two of three major problems that confront the electricity industry. The "Northeast power blackout" of 1965 underscored the first of these: the need to build a *reliable* transmission and production system. The environmentalists have called attention to the second: the importance of producing electricity in ways that neither pollute the air or sea nor destroy the beauty of the countryside. This Article will discuss a third, and interrelated problem: the need for an *efficient* system of production—a system that produces and transmits the electricity demanded at the lowest cost. The discussion will suggest that increased coordination among electricity producers can lower production costs while simultaneously allowing a given expenditure for electricity to purchase more reliability or more environmental protection.

The efficiency problem—although well known to those in the industry for some time—has recently received more public attention, as concern to save fuel resources has increased. There is a need at present for an explanation of the problem, for an estimate of its magnitude, and for a showing that those interested in designing proper public policy—particularly policy concerned with institutional or regulatory structure—should also take this problem into account when they discuss reliability or environmental protection.

While this Article will discuss the coordination problem, its major

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